International Journal of Advance Research and Innovation
Vol. 5(1), Jan-Mar 2017, pp. 157-161
Doi: 10.51976/ijari.511725

Article Info
Received: 25 Jan 2017 | Revised Submission: 20 Feb 2017 | Accepted: 28 Feb 2017 | Available Online: 15 Mar 2017

Study of Concentrated Solar Power and Their Application in Metro Stations

Hukam Singh, Shailesh Kumar Singh**, Ashutosh Kumar Rai*** and Rangnath MS****.*

ABSTRACT

The inadequate supply and the shortage of water has been taken centre stage in recent times. High expansion of population coupled with rapid industrial development in Indian subcontinent resulted in shortage of clean drinking water for people living in rural areas and remote villages especially in desert. Main components of concentrated solar power can be used in the form transparent cover, Absorber Plate, Heat transport system including fluid and Insulating Material. Besides these, tilt angle and direction with respect to Sun is also very important. Different materials available for all these components must be compared for their properties and configurations in various designs. Present study is review of various component material options improvement techniques. Current study deals with the concentrated solar power application with a case study in a metro station.

Keywords: *Concentrated Solar Power; Case Study; Metro Station.*

1.0 Introduction

Energy is an essential ingredient for human life. Energy can best be described as one of the major component for building a modern society. Energy is needed to produce goods from natural resources. Energy prevails in all sectors of society and is one of the most critical resources for human beings. Energy might best be described, in terms of what it can do. We cannot see energy, only its effects, we can not make it, only use it; and we can not destroy it, only waste it through inefficient use. Unlike food and housing, energy is not valued itself, but for what can be done with it. Energy is not end itself. Energy is a basic concept in all the science and engineering disciplines. Energy is not created or destroyed, but it is just converted or redistributed from one form to another. Understanding energy means, understanding energy resources and their limitations, as well as the environmental consequences of its use. The industrial revolution came with new energy resources: fossil fuels- like coal, then oil and natural gas. Although they are the remnants of the biomass of a remote past, these fuels are extracted from the earth's crust much more quickly than they naturally evolved. Consequently they are not renewable. Further more, these resources are undoubtedly limited, and will be exhausted in foreseeable future.So far, since the industrial revolution, energy consumption and population have been increasing by orders of magnitudes and very large inequalities between different countries are observed. Such a situation cannot last for long. It would force the countries to formulate intelligent energy policies to find ways towards the so-called sustainable development.

2.0 Litrature Review

As per John Dascomb Concentrating solar power is a method of increasing solar power density. He demonstrated the basic principle of CSP using a magnifying glass to set a piece of paper on fire. The first documented use of concentrated power comes from the great Greek scientist Archimedes (287-212 B.C.). Stories of Archimedes repelling the invading Roman fleet of Marcellus in 212 B.C. by burning their ships with concentrated solar rays were told by Galen (A.D. 130-220). Canan Kandilli dealt with the

**Corresponding Author: Department of Mechanical Engineering, Krishna Engineering College, Ghaziabad, U.P., India (E-mail: hukambij@yahoo.com)*

***Department of Mechanical Engineering, Krishna Engineering College, Ghaziabad, U.P., India*

****Department of Mechanical Engineering Delhi Technological University, Delhi, India*

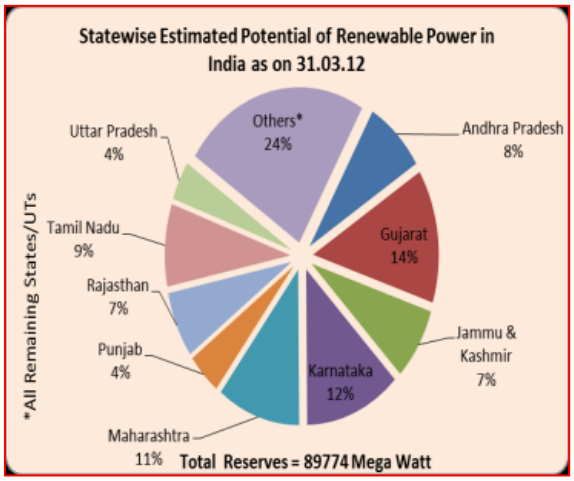
*****Department of Mechanical Engineering Delhi Technological University, Delhi, India*

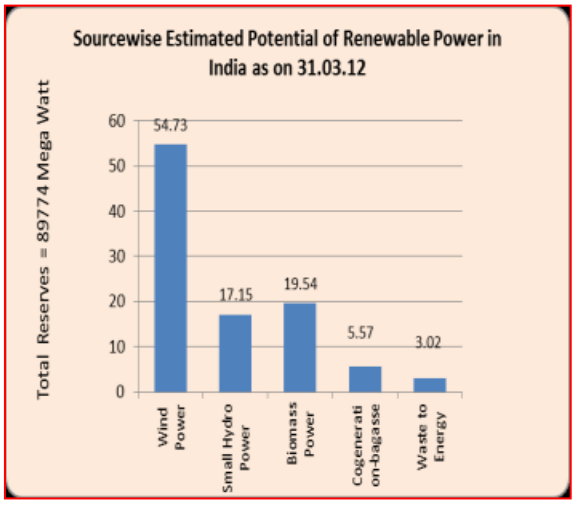
exergetic analysis and the performance assessment of the system based on the idea of transmission concentrated solar energy via optical fibres (TCSEvOF).

Wang et. al. designed three-dimensional model of parabolic dish-receiver system with argon gas as the working fluid to simulate the thermal performance of a dish-type concentrated solar energy system. The temperature distributions of the receiver wall and the working gas are presented. As per Jonathan C. Tempies studies undertaken by Eskom in 2001 identified three sites near the Northern Cape Town of Upington which are suitable for a 100 MW Concentrating Solar Power (CSP) generating plant**.**

Atmaja et. al conducted a review of how to optimize the concentrated solar power plant by increasing the stored energy capacity or by stabilizing the absorptance and emittance in the solar absorber [1-6].

Fig 1: Energy Senario





3.0 Experimental Set-up

3.1 Concentrated solar power

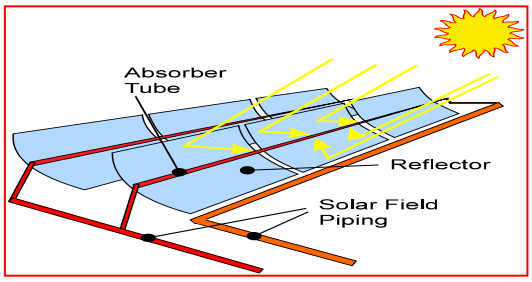
Concentrated Solar Power (CSP) systems operate on the principle of concentrating the incident solar irradiation into small enclosures via parabolic reflectors. Comparing to the parabolic trough system with the concentration ratio of 100 Suns and the central tower system with the concentration ratio of 1000 Suns, the parabolic dish system can achieve concentration ratio of 10,000 Suns. Therefore, high collection efficiencies can be achieved in a parabolic dish system due to its high concentration ratio. In addition, the quality of the thermal energy in this system is high because the receiver has very small opening and could be assumed as a blackbody. Thus, the temperatures inside the receiver are considerably higher than other types of CSP systems. Receiver fluid temperature of over 2000 K has been suggested in previous studies [7].

3.2 Types of csp

3.2.1 Parabolic trough reflectors (pfr)

Parabolic trough systems consist of parallel rows of mirrors (reflectors) curved in one dimension to focus the sun's rays. The mirror arrays can be more than 100 m long with the curved surface 5 m to 6 m across.With approximately 985 MW of installed capacity globally (REN21, 2011), parabolic trough systems embody the most mature CSP electricity generation technology. They generally consist of large arrays of solar collector assemblies (tracking groups of parabolic collectors with metal support structure, receiver tubes and tracking systems), a HTF or direct steam generation (DSG) system, a Rankine steam cycle turbine and optional thermal storage and/or fossil fuelled accompaniment [8].

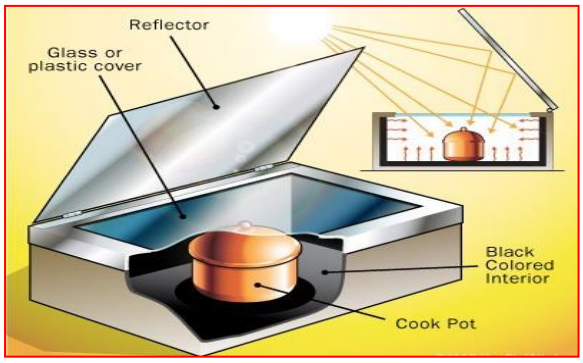
Fig 2: Solar Collector



3.2.2 Solar cooker

Solar energy used coocker is a device operating by the energy of sun for heat and cooking purpose at very low cost. Many solar cookers are relatively inexpensive although some of them are as expensive and advanced, large-scale solar cookers can cook for many people. Concerned to green revolution it is also very useful because it does not use any fuel and can be use for out-door cooking and the health and environmental consequences of alternatives are severe.[6-9]

Fig 3: Solar Cooker

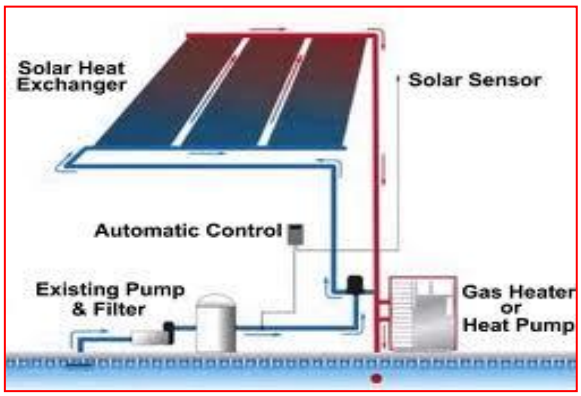


Simple solar cookers use the following basic principles: It works at the Concentrating phenomenon of sunlight by reflective mirror of polished glass, metal or metalized film from sun to required area and absorption system of light converts the sun's visible light into heat, substantially improving the effectiveness of the cooker.

3.2.3 Solar pumping

Operation of solar powered pumps is economical due to lower operation and maintenance costs and has less environmental impact compare to other engines. Solar pumps are useful where grid electricity is unavailable and alternative sources (in particular wind) do not provide sufficient energy. Solar powered water pumps can deliver drinking water as well as water for livestock or irrigation purposes. Solar water pumps may be especially useful in small scale or community based irrigation, as large scale irrigation requires large volumes of water that in turn require a large solar PV array As the water may only be required during some parts of the year, a large PV array would provide excess energy that is not necessarily required, thus making the system inefficient.[6-10]

Fig 4: Schematic Solar Pumping Diagram



4.0 Case Study

A comparative analysis of Solar Energy support mechanisms for Lighting System for a Delhi Metro Station. Electricity is used on a metro station in many forms like for running the computer system for controlling and ticketing, lighting the station, cleaning apparatus, signals etc. Lighting system does require un interrupted supply. Hence, for our study lighting system of Shivaji Stadium of Delhi Airport Metro corridor is taken. This station is underground station consist of three levels.

- Ground level
- Concourse level
- Platform level

At Ground level entrance form outside is made to the station. At Concourse level ticketing and security area is made. At platform level the metro train arrives. Reference: Study is made on the basis of respective drawings of each level

- EPMC-DTD-SHJ-E –PLAN-101/4 (Ground level Plan Lighting and Power Layout)
- EPMC-DTD-SHJ-E –PLAN-101/2 (Concourse level Plan Lighting and Power Layout)

- EPMC-DTD-SHJ-E –PLAN-001/2 (Platform level Plan Lighting and Power Layout)

4.1 Result and discussion

One of most sustainable energy source is sunlight that too is totally inexhaustible and available free of cost, as far as we know for thousands of years. Often one can use as an excellent supplement to other renewable sources. The solar energy produced is very clean with no pollutants. The burning of oil releases carbon dioxide and other greenhouse gases and carcinogens into the air. Whereas solar crematorium needs no fuel and produces no waste and no pollution. There is no any problem of global warming with solar power which is common problem with any other conventional fuels. All of us are aware of the rising cost of fuels. Although solar reflectors or combustion chamber, etc. may be expensive to buy at the onset, you can save money in the long run. After all, you do not have to pay the money for the energy from the sun. Solar reflectors are totally silent. They can extract energy from the sun without making a peep. Now imagine the noise that the giant machines used to do. Solar powered lights and other solar powered products are also very easy to install. You do not even need to worry about wires. In sunny countries, solar power can be used where there is no easy way to get electricity to a remote place. Handy for low-power uses such as solar powered garden lights and battery chargers.

In 2011, According to IEA "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. that will increase self-reliability of countries in energy matter, reduce pollution, mitigate climate change, and keep fossil fuel prices lower than otherwise.

These advantages are global. Hence the additional costs of the incentives for early deployment should be considered; they must be wisely spent and need to be widely shared.As per Energy Statics of Govt. of India, the total energy requirement by the year of 2030 for our country would increase to 400000 MWs from the existing 210000 MWs. Ideally India has to plan for 215000 MWs of power to be realized from renewable energy resources like hydel, wind, solar, nuclear and conversion of municipal waste into energy by 2030. India can generate additional solar energy to the extent of 60000 MWs by having large scale solar power plants. Gujarat State has already generated 680 MWs of solar electric power through public-private partnership program and the power is being fed to the grid. Here we have to consider the reduction in load factor in solar, wind and hydel which will necessitate generation of 20 to 30.

5.0 Conclusions

Solar power can play a significant role in a secure and diversified energy future for India as the country becomes a hub for solar projects. More specifically, concentrated solar power (CSP) could have a unique role in India's energy mix. Its potential to use hybrid technologies and easily add storage could unlock dispatch-able and base-load power, setting the stage for larger renewable energy penetration. In middle east and North Africa the solar energy offers a unique opportunity for competitive, secure and sustainable energy for electricity and seawater desalination.CSP is present state of the art, the resources are almost unlimited, and the necessary investments are affordable. The resources exceed by far the present Middle East oil exports and are still untapped.

While projects are already in operation or being built for electricity generation in the US and Spain, the basic engineering of a first plant for the combined generation of electricity and heat for power, cooling and seawater desalination started in Aqaba, Jordan in 2007. It will be the first economically competitive solar power station without any financial public support. CSP is of vital importance for the MENA region, as it is the only available resource that is large and affordable enough to cope with the challenge of growing electricity consumption and increasing shortage of potable water. It will, however, take at least a decade to introduce noticeable CSP shares into the energy portfolio. Some conclusions have been drawn by the above case study-

- Concentrated solar power technologies are very efficient in compare to conventional energy collectors**.**
- Case study is also showing the application of concentrated solar energy system is eco-friendly compare to conventional system.
- Concentrated solar power by using hybrid technologies and easily add storage could unlock dispatch-able and base-load power, setting the-

stage for larger renewable energy penetration Large amount of reduction in carbon dioxide is confirming by the application of solar system in metro station.

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